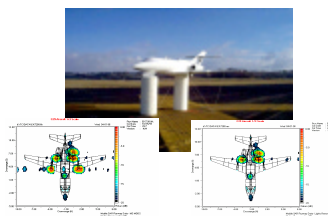


## Motivation, Background, Experience

- MRC has been investigating near field techniques for assessing the RCS characteristics of low observable (LO) vehicles (LOPHM) for several years
  - ➔ **Motivation:** assessing the RCS (stealth) characteristics of LO vehicles is a critical element of real time mission planning and turn-around
  - ➔ **Motivation:** if the RCS characteristics are anomalous we are interested in determining the cause (defect detection and localization)
  - ➔ **Conventional Approach:** Far field RCS characterizations are difficult to control, time consuming and expensive
  - ➔ **New Approach:** Near field techniques are cheaper, easier to control and can be related via statistical techniques to far field RCS characteristics
- MRC has experience with near field signature characterization and measurements
  - ➔ Mobile Diagnostic Laboratory (MDL)

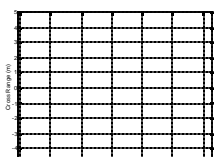


## Simulation of Near Field/Far Field Scattering and Detection Results

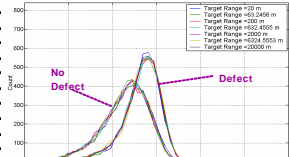
- Extensive simulation work shows that statistical characteristics of near field measurements are highly correlated with far field RCS quantities



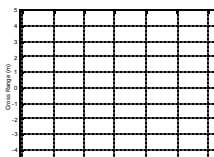
Simulation Geometry for Point Scatterers



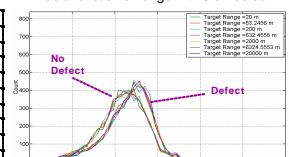
Point Target Scatterer Locations



Histogram of Scattering Power as a function of range with 6 dB defect



Edge Scatterer Locations



Histogram of Scattering Power as a function of range with 6 dB defect



Edge Scatterer Geometry

## Estimating Far Field Scattering Statistics from Near Field Measurements

- Approach based on statistical detection theory
  - ➔ Radar scattering from complex targets (i.e., electrically large) fluctuates as a function of aspect angle
  - ➔ This type of fluctuation is often best described probabilistically - as a random process (especially data taken in dynamic conditions).
  - ➔ Problem becomes one of determining whether the signature fluctuation statistics seen from a target are
    - consistent with a baseline statistical model or
    - are due to a defect or an anomaly in the target structure
  - ➔ The statistical problem statement is stated as follows:

**Basic Problem:** Given the training and test data associated with the  $i$ th angular region  $\Theta_i$ , the problem is to decide whether the test data is more likely to be associated with the training data for the control target(s) or associated with one of the training sets associated with the defective signature data.

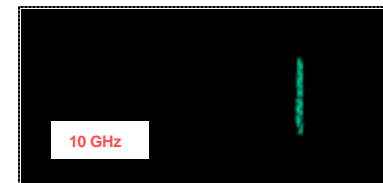
- ➔ One approach is a Neyman-Pearson Test:

$$L(d) = \frac{p(d|H_0)}{p(d|H_1)} \leq \gamma$$

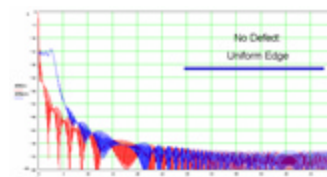
where  $d$  is the measured data and the two hypotheses,  $H_0$  and  $H_1$ , are associated with the target without and with anomalous scattering defects

## Long Edge Scattering Doesn't Follow the Isotropic Point Scattering Model – Long Edges Pose Unique Problems

- Simulation work has shown that special care must be exercised around the specular reflection arising from long edges

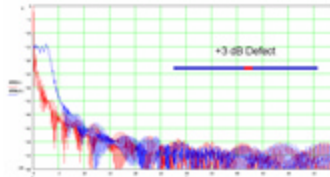


Simulation Geometry for Point Scatterers



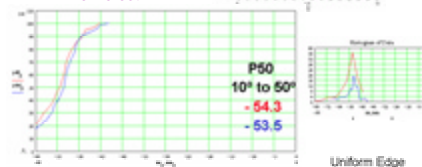
Red: Range = 120,000 ft  
Blue: Range = 120 ft

No Defect

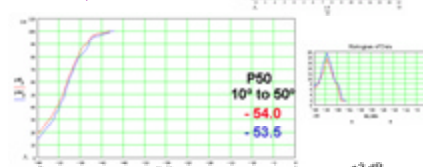


Red: Range = 120,000 ft  
Blue: Range = 120 ft

1 ft, 3dB Defect



Uniform Edge



+3 dB